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PITFALLS OF THE DEFENSE ACQUISITION SYSTEM - EXPERIENCE IS THE KEY TO SUCCESS

BY

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14. ABSTRACT

This paper researches the Department of Defense's Acquisition Policy and Process and provides the potential pitfalls that an ACAT 1D program can face as it progresses from Technical Development and into System Design and Demonstration (SDD). The inquiry will be accomplished by examining the Aerial Common Sensor (ACS) (ACAT 1D) Airborne Intelligence Surveillance and Reconnaissance program as a representative case study. The Department of Defense's Acquisition Process has been called into question several times over the last twenty years. The induced acquisition reform cycles and changes to the guiding acquisition regulation series have resulted in updates to the material acquisition process for ACAT 1D programs. These process changes provide confirmation for the Department and Services of a program's preparedness to proceed to a Milestone B decision and into SDD. While the process and checks are designed to ensure program success measured by adherence to Acquisition Program Baseline cost, schedule and performance limits, programs continue to breach one or more of these measures. In the first quarter, FY06, of the eighty-five programs reported to Congress in the Selected Acquisition Report, 47% reported Nunn-McCurdy unit cost breaches. This analysis reviews the DoD acquisition policy and reform initiatives and then researches the current DoD acquisition policy and process as it was applied to the ACS program. This paper then researches the current process pitfalls that affected the ACS Program. This is followed by an analysis of the recent Defense Acquisition Process Assessment and discusses whether it will be effective in causing meaningful reform. This paper then suggests changes that should be made to the acquisition process and provides insights that can be used to help future programs avoid the pitfalls that the ACS program faced during its contract execution.

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CIVILIAN RESEARCH PROJECT

PITFALLS OF THE DEFENSE ACQUISITION SYSTEM – EXPERIENCE IS THE KEY TO SUCCESS

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ABSTRACT

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The Department of Defense's Acquisition Process has been called into question several times over the last twenty years. The induced acquisition reform cycles and changes to the guiding acquisition regulation series have resulted in updates to the material acquisition process for ACAT 1D programs. These process changes provide confirmation for the Department and Services of a program's preparedness to proceed to a Milestone B decision and into SDD. While the process and checks are designed to ensure program success measured by adherence to Acquisition Program Baseline cost, schedule and performance limits, programs continue to breach one or more of these measures. In the first quarter, FY06, of the eighty-five programs reported to Congress in the Selected Acquisition Report, 47% reported Nunn-McCurdy unit cost breaches.

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should be made to the acquisition process and provides insights that can be used to help future programs avoid the pitfalls that the ACS program faced during its contract execution.

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PITFALLS OF THE DEFENSE ACQUISITION PROCESS – EXPERIENCE IS THE KEY TO SUCCESS

Introduction

"There is a growing and deep concern within the Congress and within the Department of Defense (DoD) Leadership Team about the DoD acquisition process. Many programs continue to increase in cost and schedule even after multiple studies and recommendations that span the past 15 years. In addition, the DoD Inspector General has recently raised various acquisition management shortcomings."

— Gordon England, Deputy Secretary of Defense, June 2005.

The effectiveness of the Department of Defense's (DoD) acquisition process has been called into question many times over the last 35 years due to the inability of the process to consistently deliver required capability to the warfighter on cost and within schedule as estimated and described in a program's start-up documentation (Acquisition Program Baseline - APB)[1]. Due this inability to execute a program on targeted cost and within established schedule, Congress, the warfighter and the American people have lost confidence in the DoD's ability to effectively manage its investment account budget. This in-turn causes calls for more and varied oversight and regulation of the acquisition process for large Acquisition Category 1D (ACAT 1D) programs resulting in additional burdens on a programs ability to effectively execute system development and adding to the potential of a program not achieving its APB[2]. From a historical perspective, this appears to be a cycle that DoD is unable to break but one that now more than ever must be broken based on ongoing competing needs for the finite budget available[3].

This continual problem with the DoD acquisition process has induced several acquisition reform cycles and ultimately changes to the guiding acquisition directives over the years resulting in updates to the material acquisition process for ACAT 1D programs[4]. These process changes have for the most part centered on attempting to provide confirmation to the Defense Department and Services of a program's preparedness to proceed to a program start (Milestone B) decision and into the development phase - System Design and Demonstration (SDD). Specifically, the recent changes direct the use of best practices[5] that are captured in the approximately thirty-five separate documents that the program manager, as well as the service

and OSD staffs must produce and provide to the program's reviewing officials as it winds it way through the briefing and approval process to a Defense Acquisition Board (DAB) Milestone B decision[6]. While the adoption and use of best practices as described in the current DoD Directive 5000.1 and Instruction 5000.2 are designed to ensure program success as measured by delivering the required capability to the user at the cost, and within the schedule outlined in the APB, programs continue to significantly breach one or more of these measures. In the first quarter, FY06, of the eighty-five ACAT 1D programs reported to Congress in the Selected Acquisition Report, forty programs reported Nunn-McCurdy unit cost breaches with twenty-five of these reporting greater than 50% unit cost growths[7].

The best practices required by the DoDI 5000.2 documentation are based on prior acquisition reform studies that called for needed change in the process based on lessons learned through the analysis of prior programs that were unable to deliver a capability on cost or within schedule as estimated at program start. While these required documents cause a program manager and Service/OSD staffs to think about a particular best practice process area, what they appear to lack is a treatment of the lessons learned and the pitfalls faced by the previous program that the best practice is designed to mitigate. Therefore, while a program manager and the staffs of Service and OSD reviewing officials must create documents because of the directive's call for adherence to best practice processes, whether the PM or Service/OSD staffs fully recognize the pitfalls that the best practice was designed to ameliorate is not assured.

The Aerial Common Sensor (ACS) program is an ACAT 1D program due to its expected cost and joint interest. The intent of this program is to fill a capabilities gap that will soon exist for both the Army and Navy as the current Airborne Intelligence Surveillance and Reconnaissance aircraft of each service reach the end of their useful lives[8]. ACS had successfully accomplished the Component Advanced Development (now called Technology Development (TD)) phase of its life-cycle a month after the publishing of the current DoD 5000 series in May of 2003. Hence, the best practice processes and documentation requirements that the program followed as it proceeded from TD to a DAB Milestone B decision are those outlined in the current DoDI 5000.2. However, after a successful DAB decision to proceed into System Design and Demonstration (SDD) and within four months after contract award, the program began suffering from system design issues that ultimately would impact the program's ability to

meet its documented system delivery date. By September 2005, the extent of the design issues and estimated schedule slip had grown to the point that the program was called before a special Army Systems Acquisition Review Council. This council recommended contract termination that occurred on 12 January 2006 only a year and a half after the SDD program started[9]. While there is disagreement on whether the ACS program fully followed all the best practice processes as outlined in the DoD 5000 instruction, what becomes apparent upon analysis of the programs history is that even though the best practice documentation was fully developed, the understanding of the extent of the potential pitfalls of this phase of the program's life-cycle were not readily recognized.

Capturing and understanding best practices appears to have been gaining attention across the Executive Branch of Government over the last four years. As DoD and the rest of the Executive Branch work to transform themselves into organizations that are more efficient, the need to change the way they do business has centered on whether the current processes are based on best practices resulting from lessons learned from the pitfalls faced by previous efforts. For instance, The SDD phase of a program's life-cycle received much attention in the February 2006 *Defense Acquisition Performance Assessment* (DAPA) study accomplished at the request of Acting Deputy Secretary of Defense Honorable Gordon England. In this study, acquisition process reform is discussed from a holistic "big-A" perspective including stake-holders such as the requirements community and Congress not traditionally considered part of the "little-a" DoD acquisition process. This perspective of reform discussion brings to light pitfalls acquisition programs face in the SDD phase of a program's life-cycle. Many of these pitfalls are the same as those that were experienced by the ACS program. The study then makes recommendations that focus on accounting for these pitfalls with the ultimate goal being speeding-up the delivery of capabilities to the warfighter[10].

This reform study is part of a larger on-going business transformation effort which was outlined in 2002 by President Bush in his President's Management Agenda. This agenda calls for all federal agencies to be customer focused and to establish a set of metrics by which to measure the success of their best practice processes designed to reduce time for delivery of capability or products to the customer. The focus again is understanding and avoiding pitfalls that would negatively impact the ability to accurately estimate a program's cost and schedule to deliver

required capability to the user. This business transformation effort also requires that the processes be reviewed and updated on a regular basis in an effort to continually decrease the time needed to deliver product to the user while also reducing cost[11].

Considering the apparent focus of the Executive Branch and DoD on best practices, why is it that so many ACAT 1D programs continue to be unable to accomplish their stated goals with respect to cost, schedule and performance? From the analysis, it appears that the current DoD acquisition process and support structure for ACAT 1D programs while being committed to the use of best practice processes still have not incorporated a unified lessons learned methodology for capturing, disseminating, and mitigating—through continued best practice process improvement—potential pitfalls that an ACAT 1D program entering SDD could face. "The current system is focused on programs, not on improving and standardizing the processes of acquisition; it inhibits rather than promotes steady improvement in achieving program success"[12].

This paper researches the question above and provides suggestions for the types of pitfalls that a program can encounter which could impede the path to successful delivery of warfighter capability on target cost and within schedule. To accomplish this, the ACS program will be used as a case study of a representative ACAT 1D SDD program that even though it followed the current DoD acquisition process fell victim to the pitfalls that could have been mitigated had they been known before hand. Additionally, the paper will make recommendations on how to improve the current acquisition process by developing a unified lessons learned methodology.

Acquisition Reform and DoDD/I 5000.1&.2

"The unpredictable nature of Defense programs can be traced to instabilities in the broader acquisition system. Fundamentally reshaping that system should make the state of the Department's major acquisition programs more predictable and result in better stewardship of the U.S. tax dollar. There are several ongoing reviews of defense acquisition improvements being conducted both within and outside the Department in an effort to address these issues. Their results will inform the Department's efforts to reshape defense acquisition into a truly 21st Century process that is responsive to the joint warfighter."

— Quadrennial Defense Review Report 2006

General Accountability Office (GAO) studies have shown that acquisition best practices in commercial industry are knowledge based. Decisions concerning the use of technology, expected capability, program cost, program structure and moving from one phase of the acquisition process to the next are based on information gained thru the use of metrics that indicate to a PM and corporate leadership when the unknown risks have been reduced to an acceptable level to proceed. This translates into confidence in a products expected development cost and schedule which ultimately reduces overall cycle time to bring a product to market. This knowledge-based approach to acquisition has become a process that is depicted graphically in Figure 1.
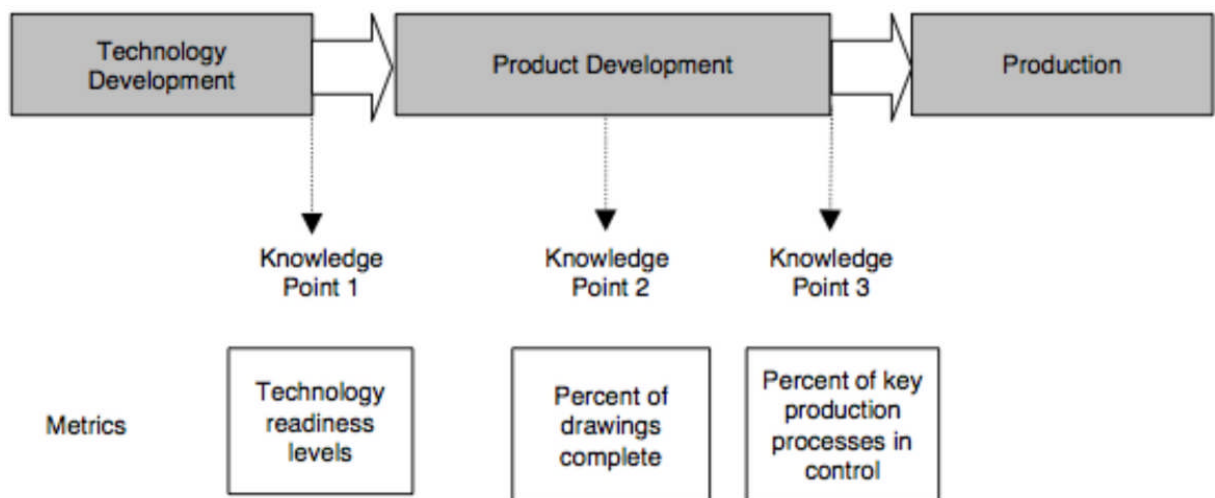
Figure 1. Knowledge Based Acquisition Process[13].

In this knowledge-based acquisition process, a program only moves forward to the next phase when it has met certain controls/addressed certain potential pitfalls that would otherwise leave unaccounted for risk in the program that could result in unexpected cost and schedule growth. Specifically, at Knowledge Point 1 (program start) "requirements and technology are matched"[14]. Hence, a program must demonstrate the maturity of the technology to be used with which to develop the product. If the technology has not reached a maturity level at which the risk to proceed to product development is considered low, then either the technology is first matured before proceeding or the requirements are phased such that the current technology

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delivers a portion of the products expected capability. Technology maturity is paramount at Knowledge Point 1. The expected level of maturity before a technology is considered ready to be incorporated into a product design is one that has moved "from a concept to a feasible invention to a component that must fit onto a product and function as expected"[15]. Using the technology readiness scale introduced by the National Aeronautics and Space Administration and now adopted by DoD, this level of maturity would be at a level eight. Technology Readiness Level eight (TRL - 8) "is a technology that has been proven to work in its final form and in its intended operating conditions. A radio at this level would have been installed in the instrument panel in the aircraft cockpit, integrated with other aircraft systems, and flown under all expected conditions"[16].

Beyond the control of technology maturity, there are several other key controls in place in the "Best Practices (acquisition) Model" used by commercial firms successful in product development. These controls all further the level of knowledge of a products ability to meet requirements at a particular cost and schedule by forcing potential pitfall areas to be eliminated before commitment to product development. Specifically these are: "Ensuring that requirements for the product are informed by the systems engineering process; Establishing cost and schedule estimates for product based on knowledge from preliminary design using systems engineering tools; Conducting decision reviews for program launch; and that the producer has completed a preliminary design of the product"[17].

Knowledge Point 2 occurs when the integration of the technologies is complete and before the program moves into product demonstration. As with the previous knowledge point, there are several controls in place to ensure that the product design is at a level of maturity to instill confidence in the corporate review board that product development is ready to proceed. The key metric at this point as stated in Figure 1 is "percent of (product design) drawings complete". Specifically, the expected percentage of drawing complete at this point is 90%. Based on this, the design is expected to be stable and demonstrated through prototype testing that it meets requirements[18].

Knowledge Point 3 occurs when the product is ready to begin production. At this point, production controls are in place that will ensure that the product will be "manufactured within cost, schedule and quality targets." Also, by this time the product's reliability is known through

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demonstration. The key metric for this knowledge point is the "percent of key production processes in control." Specifically, leading manufacturers expect to have all of their key production processes under statistical process control prior to entering into production "such that the quality, volume, and cost of their output (have) proven acceptable"[19].

While using knowledge based acquisition practices was a focus of the DoD 5000 series documentation published in May 2003, the idea of using knowledge based best practices in DoD system acquisition is not a new concept. Several of the controls discussed above were recommended over 20 years ago in the June 1986 Packard Commission's "Presidents Blue Ribbon Commission on Defense Management". Here the Commission looked at successful commercial manufacturers and government programs and distilled best management practices that led to products being brought to the user on cost, and within schedule. With respect to technology maturity the commission recommended developing "subsystems and components independent of the development of a weapon system" and the use of "…prototypes and less reliance on paper studies." The Commission also recommended that a new acquisition policy should assure that "maintainability, reliability, etc" are provided by "other means than detailed documentation by contractors as part of design proposals." The study recognized that "full-scale development of a new weapon system is the single most critical step in the acquisition process. At this point, a number of fundamental decisions must be made: whether to undertake a new development or adapt an existing system, how far to push the new technology being incorporated in the system, what cost and schedule to authorize, and what the management structure will be. Misjudgment about any of these items can start a program off on a course that dooms it to failure"[20]. Therefore, knowledge is needed to ensure that the right decisions are made so the program starts on a path to success. However, in the July 1986 GAO report discussing Defense Acquisition Improvement, the study team noted that DoD was not executing its materiel acquisition process based on best practices as recommended by the Packard Commission. Specifically, they stated that DoD's "inability to submit realistic and affordable defense programs and budgets to the Congress for the development and procurement of weapon systems" has been "because they have not always included all expected costs, or provisions for the technological risks associated with acquisition of high technology weapons"[21].

Seven years later, the 1993 the Defense Science Board recommended as part of its overall study entitled *Defense Acquisition Reform* that DoD should increase its use of commercial best practices to streamline the acquisition process in an effort to reduce defense acquisition program cost and schedule. Specifically, the study encouraged the increased use of "commercial and commercial-like" [best] practices to the point that "no systematically applied unique accounting practices, specifications, procurement requirements, reporting systems, and management practices would be required beyond those normally practiced in US industry." Here the focus was on allowing industry to more openly participate in the defense acquisition process and to open DoD to the use of commercial based products. The idea being that by doing this the success achieved by the commercial industry acquisition process would translate to the defense acquisition process[22].

In June 1994 the Under Secretary of Defense for Acquisition Logistics and Technology (Acting) and the Assistant Secretary of Defense for Command Control, Communications and Intelligence co-signed a memorandum to the Services entitled Software Acquisition Best Practices Initiative. This memo directed the identification of "criteria-based practices" used by successful software development efforts in both the Government and civilian sector that could be disseminated and used by all software development efforts in DoD. The goal of this initiative was to:

> " - Focus the Defense acquisition community on employing effective, high-leverage software acquisition management practices;
>
> - Enable Program Managers to focus their software management efforts on producing quality software, rather than on activities directed towards satisfying regulations that have grown excessively complex over time;
>
> - Enable Program Managers to exercise flexibility in implementing best practices within disparate corporate and program cultures; and,
>
> - Provide Program Managers and staff with the training and tools necessary to effectively use and achieve the benefits of these practices"[23].

Since 1996 GAO has recommended the use of corporate best practices within DoD to improve the acquisition process. Specifically, the GAO recommended the use of knowledge based best practices and metrics (controls which eliminate pitfalls/risk) to be established that measure the attainment of knowledge levels before proceeding with the commitment of product

development. The rationale being that the use of these best practice acquisition processes have been proven in industry to be highly effective in delivering products to market on cost and within schedule, and by implementing these practices, DoD could also benefit[24][25].

In the 2001 DoD Quadrennial Review, the theme was transformation of the DoD business practices to meet future challenges. Action items were to realign services to a joint focus, reduce institutional cost and reduce cycle time delivery of capability to the warfighter. To accomplish this, one of the needed improvement areas called for in the review was reform of the DoD acquisition process. By reforming the DoD acquisition process along with other areas the review stated "…truly dramatic improvements in future joint operational effectiveness (could) be achieved"[26].

Current Defense Acquisition System - DoD 5000.1/.2 and Guidebook

It is the history described above of calls for acquisition reform that set the stage for current DoD Acquisition Process. The current process was established in May 2003 with the publishing of the updated Department of Defense Directive (DODD) 5000.1 and Department of Defense Instruction (DODI) 5000.2. A quick review of the current Defense Acquisition System, shows that DoD heeded the recommendations for reform and established an acquisition process focused on the commercial best practice of knowledge-based acquisition. Like the commercial Best Practices Model, the current DoD process calls for a phased approach to weapon system acquisition that requires the attainment of knowledge about the system to be built before committing to product development or product production. This concept consists of five phases: Concept Refinement, Technology Development, System Development and Demonstration, Production and Deployment, and Operations and Support. The process is graphically portrayed in Figure 2[27].
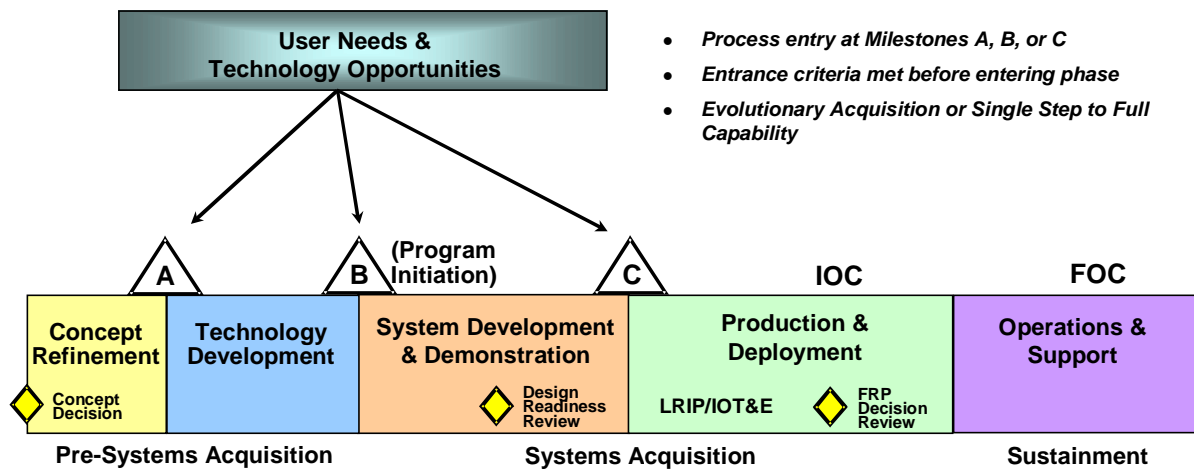
Figure 2. Defense Acquisition Management Framework.

Before each phase is entered there is a decision point at which the Milestone Decision Authority (MDA) must give approval before the program is allowed to move into the next phase of the acquisition process. These decision points are Milestone (MS) A, B and C and mark the transition from the Concept Refinement to the Technology Development (TD) phase (MS A), from TD to System Development and Demonstration (SDD) phase (MS B), and from SDD to Production and Deployment (PD) phase (MS C). At MS A, B or C a PM must show a certain level of knowledge about the system has been attained before being allowed to proceed. This is normally demonstrated by the program meeting established exit criteria for one acquisition phase and entrance criteria for the next. These exit and entrance criteria have associated with them specific documentation requirements that describe program/system maturity indicative of what has been established as a best practice knowledge level. The concept is that by attaining this knowledge level a program will be on the path to success upon entering the next phase of the acquisition process[28].

MS B - Transition from TD to SDD

For instance at MS B (which is arguably the most important decision point in the acquisition process since this is the point at which an acquisition program is established)[29] a PM for an Acquisition Category 1D (ACAT 1D)[30] program in concert with the Service and OSD staffs must produce and submit up to as many as 35 documents to demonstrate the level of knowledge maturity—or "business case" in commercial industry parlance—for the program to

leave the TD phase and enter SDD. The primary focus of the TD phase is to determine and then mature the critical technologies of a proposed system to the point they have been "demonstrated in a relevant environment and a system (based on these technologies) can be developed for production within a short timeframe (normally less than five years)". The establishment and maturation of critical technologies is a collaborative and "iterative process designed to assess the viability of technologies while simultaneously refining user requirements"[31]. The culmination of the TD phase is a match between mature technologies, user requirements and funding such that a specific spiral or increment of system capability can be developed and provided to the warfighter quickly once the program has attained a successful MS B decision and entered into SDD.

To this end and in keeping with policies of Flexibility, Responsiveness, Innovation, Discipline, and Streamlined and Effective Management defined in DoDD 5000.1, the MDA along with the PM shall establish the structure, practices and documentation that will be used to "acquire quality products that satisfy user needs with measurable improvements to mission capability and operational support, in a timely manner, and at a fair and reasonable price." Table E3.T1 of Enclosure 3 to DoDI 5000.2 lists the 35 key documents categorized as either Statutory or Regulatory that have been determined to provide the minimum level of program information necessary make a decision on the "business case" at MS B to proceed from TD to SDD phase[32]. This list is supplemented by the Defense Acquisition Guidebook, which provides an online set of references covering "non-mandatory guidance on best practices, lessons learned and expectations"[33].

The Technology Readiness Assessment and accompanying Independent Technology Assessment are examples of key regulatory documents used to determine the program's critical technology maturity and readiness to proceed into product development. The Defense Acquisition Guidebook and Technology Readiness Assessment Deskbook have additional best practice and expectation reference information listed for these documents. In the Deskbook, extensive treatment is given to the explanation of technology readiness levels used to define technology maturity and the responsibilities of both the PM and the independent technology assessment team responsible for providing a true assessment of a technology's maturity. While the DoD policy stipulates that technology rated at a TRL of 6 or less can be brought into the

SDD phase if required and with appropriate guarantees/waivers, the Deskbook goes to great lengths to explain—using GAO citations of commercial best practices and numerous DoD failures—why a TRL 7 (technology at a prototype maturity level that has been demonstrated in an operational environment) or better should always be used.

Other key documents in the DoDI 5000.2 table listed as statutory requirements for MS B include the Acquisition Program Baseline, Independent Cost and Manpower Estimates, Selected Acquisition Report, Low Rate Initial Production Quantities, and the Technology Development Strategy. As with the Technology Readiness Assessment, and the other regulatory documents, all of these statutory documents have amplifying information about them in the Defense Acquisition Guidebook that provides further detail about what the document is for, hyperlinks to the requiring laws, timeframes for their submission, and when available a link to further detail about best practices and document templates. Along with the amplifying document information the Guidebook provides PMs with "with discretionary best practices that should be tailored to the needs of each program." This information is broken into chapters "designed to improve understanding of the acquisition process and ensure adequate knowledge of the statutory and regulatory requirements associated with the process"[34].

The ACS Program

It was with the development of these documents, using the references and amplifying information in the Defense Acquisition Guidebook, that the Aerial Common Sensor (ACS) program proceeded through the Defense Acquisition System review process to a MS B decision. At each stage of the review process details of the documents were presented to the decision authorities who based on this information considered the program ready to proceed. Because of the lack of major issues or discussion topics concerning the program's readiness to proceed to a MS B Defense Acquisition Board (DAB) Review, the program was allowed to forego the formal DAB meeting and instead was approved for transition to SDD via circulating among the board members for their approval the document/briefing chart package that would have been presented had the meeting taken place. With the approval of the all of the board members following the addition of funding to the program required by the Cost Analysis Improvement Group, the

program was approved for transition into SDD. The ACS Acquisition Decision Memorandum was published on 29 July 2004[35].

Why Use ACS as a Case Study?

The ACS program is unique in that it is an ACAT 1D program where the timeline from pre-SDD activity, SDD start, and SDD contract termination occurred in a three year period and one product manager's tour of duty with all senior leaders in place from the beginning to the end of this time period. These facts provide a unique situation and view into events that normally take several more years and many more players before they come to light in the current acquisition environment. Beyond this, internal and external teams both have reviewed the program's events that led to its contract termination during the final months of the contract's execution and immediately following contract termination. Capturing the accounts of what occurred or didn't as seen by differing points of view—while the events are still relatively fresh in the minds of those that participated along with the documents supporting the program still in place and easily reviewed—provides a unique opportunity to determine what actually happened and to gather lessons learned. Also of note is that while the ACS SDD contract has been terminated, the program remains in post MS B status and has a program element funding line expecting a development contract restart in the FY09 timeframe. This gives the members of this program an opportunity of a second chance at success by using the lessons learned form the first attempt. Such an opportunity is something rare in the current budget environment.

ACS Program Background

The ACS system is designed to meet the Army and Navy's future airborne intelligence, surveillance, and reconnaissance requirements. It is intended to be a multi-intelligence (MULTI-INT) system meaning that it is required to carry not only a signals intelligence (SIGINT) collection capability, but also imagery intelligence (IMINT), and a measurements and signatures (MASINT) collection capability. The system will allow the retirement of both the Army's Guardrail/Common Sensor (GR/CS) and Airborne Reconnaissance Low (ARL) aircraft systems as well as the Navy's EP-3E aircraft fleet. To meet the retirement needs of theses systems, the Army planned for the ACS initial operational capability to occur in 2010. The ACS program entered System Development and Demonstration (SDD) on 29 July 2004 based on the

acquisition decision memorandum signed out by the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD, AT&L) of the same date.   Prior to this date, the ACS program had successfully completed both the Concept Exploration (CE) and Technology Development (TD) phases of the program life-cycle. In 2003, as the Army ACS program was completing its TD phase, the Chief of Naval Operations (CNO) directed that the Navy enter into a partnership with the Army for the ACS procurement. This partnership was recognized by the Army leadership (Army Acquisition Executive and Vice Chief Staff Army) during the August 2003 ASARC meeting held to confirm that the ACS program successfully met the exit criteria for the TD phase and was prepared to enter into the process of obtaining a MS B decision.

On 20 October 2003, the Joint Requirements Oversight Council (JROC) approved the Army's Operational Requirements Document (ORD). While the Army's ORD was considered by the Navy to meet approximately 98% of its operational requirements, in September 2003 the Army agreed to add two additional manned workstations to the baseline aircraft system configuration to accommodate Navy mission needs. The remainder of Navy's requirements were captured in the Navy ACS ORD Annex that was approved by the JROC on 3 May 2004. The Navy's plan was that as Navy funding became available they would add the additional annex capability to the ACS system.

The ACS program had now evolved in the last year before the MS B decision from an Army only ACAT III program to a Major Defense Acquisition Program (ACAT 1D) with joint oversight interest and the Navy considered to be an equal partner. Based on historical ownership and service funding levels, the agreement was that the Army would remain the lead service. For the SDD phase of the program, records show that the Army was expected to fund $1.1 billion of the development effort with the Navy funding $170M. The concept for program execution was that the Army had contract responsibility and program management responsibility through the Army Acquisition Executive, and the Assistant Secretary of Defense for Networks, Intelligence and Information (ASD/NII) to Defense Acquisition Executive as the Milestone Decision Authority. This put overall program execution responsibility on the shoulders of the Army's Lieutenant Colonel level Product Manager.

ACS: What Happened?

In September 2004, one month after contract award, the Army, Navy and contractor along with the Defense Acquisition University (DAU) teams met for a post award conference. With DAU as the post award conference facilitator—something they had done on a recent Navy program start-up—joint vision and mission statements were created, and Government (Army/Navy)/contractor Integrated Process Teams (IPT) were chartered for each of the functional areas of system development. In December 2004, during the first Kaizan event held by the aircraft IPT, it became apparent that the estimated weight of the ACS payload was 100 pounds over the structural limit of the modified commercial aircraft that was part of the contractor's system design. This put the ACS system in a situation where the aircraft sub-system could not take-off.

Starting in January 2005, the contractor brought into the program weight reduction experts from the F-22 and C-130-J programs to find areas in the design where weight could be reduced. To accomplish this, they accelerated portions of the design to gain greater fidelity on the exact weight drivers. However, instead of reducing weight as the design matured, the opposite happened and the expect weight of the system design continued to grow. What became apparent as the system design matured was that several required areas of the payload infrastructure had either been overlooked or considerably underestimated.

One area of underestimation, which became a focal point during the post-contract termination Congressional reviews of the program, was the total cable weight required to connect the numerous signal collecting antennas on the wings and fuselage of the aircraft to the intelligence processing boxes had been underestimated. Another area of "realized" weight during design maturation was the aircraft structural design changes made to attain required flight altitude and endurance. While the flight altitude and aircraft endurance were non-Key Performance Parameter (KPP) requirements set forth in the ORD, they became driving requirements for the program and equivalent to KPPs based on Army and Navy user's detailing their concepts of operation (CONOPS) for the system during the Government's source selection process prior to contract award. This made it almost impossible to make any trades to reduce weight in this area. Other areas where design maturation uncovered additional weight were the areas affected by the use of the military specifications requiring that the aircraft/payload to be

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able to survive a 16G crash versus the commercial requirement of surviving a 9G crash. The Government's Aircraft Qualification Plan, which delineated aircraft/payload survivability "G" ratings and was provided to the contractor during source selection, had been provided back to the Government by the contractor in its final proposal submission with a change reducing the survivability rating from 16 to 9Gs. The 16G aircraft survivability requirement called out in the Government's version of this document was still under negotiation between the SDD contractor and the Government at contract termination.

By March 2005, it was apparent that the contractor's selected aircraft could not meet the full set of payload requirements due to the payload/infrastructure weight. Reduced payload, flight altitude and endurance capable ACS system options were reviewed. While several of the options were found to be KPP compliant, the user communities of both the Army and the Navy found all options to be unacceptable based on overall system performance not meeting the needs of the service's CONOPS being developed in detail concurrently. At this point, the Army and Navy Program Executive Officers (PEO) determined that larger payload capable aircraft should be reviewed with cost and schedule implications addressed to determine if viable program options were available within the assigned Acquisition Program Baseline (APB).

The ACS PM submitted a program Schedule Deviation Report (SDR) in May 2005 to the MDA to inform him that an APB schedule breach was expected on the ACS program. Even though the contractor committed to and began tracking earned value metrics against its internal baseline for the program in December of 2004, due to the ability of the Government/contractor team to close on a design that provided needed system capability, the Government did not accomplish the customary Initial Baseline Review (IBR) to validate and accept the contractor's program baseline. Although there was no formal Government approved program baseline, the PM submitted the SDR because it was quite evident, even from the non-validated program earned value measurement (EVM) statistics, that the weight issue the program was experiencing and the resulting effort to rectify the problem was keeping the contractor from completing expected contracted work packages during the same timeframe. This meant that the program's major milestone events such as the System Requirements Review and Preliminary Design Review were either being executed unsatisfactorily or not at all.

The Government/contractor ACS team evaluated several larger aircraft based program options. All options that were expected to meet the ORD and CONOPS performance requirements breached the APB in both cost and schedule. In July 2005, these higher cost estimates were validated by the external non-advocacy review (NAR) team commissioned by the Army PEO to review the program's viability. The NAR, consisting of senior acquisition experienced personnel from both the Navy and Army, conservatively estimated that a viable SDD program would cost between $2.5B - $2.9B depending on whether the estimate was for an Army only program or included Navy test assets respectively. This was over 100% more than the APB expected SDD cost of $1.2B. Interestingly, during this program option review, the baseline ACS SDD program was also redressed. The Government/contractor team found that instead of the baseline ACS development effort costing the contracted $820M it was now estimated to cost $1.1B for the contractor to develop a system that by this time had been determined could not take-off (1.1B is a contractor only cost which does not include the estimated $100M for Government program office operating costs for the length of the development effort).

On September 14, 2005, the Army issued a Stop Work Order (SWO) to the contractor for all contracted efforts. This decision was made following an emergency ASARC that was called by the Army Acquisition Executive to review a recommendation for contract termination made on 8 September 2005. The SWO called for the contractor to focus efforts on "alternate strategies for Army consideration that maximize possible performance while minimizing negative cost and schedule impact to the Government"[36]. With this direction, the contractor was provided the opportunity to take sixty days to develop a "written plan" that demonstrated their best effort to meet the needs of the user while minimizing cost and schedule. The contractor provided three system options based on three different aircraft. While two of the aircraft system solutions met or exceeded KPPs and the critical driving threshold requirements of altitude and endurance, the cost and schedule of each breached the APB. The third aircraft solution was based on the original planned contractor aircraft and design concept. While this aircraft based design met the ORD KPPs, it required the user to accept a significantly reduced capability in the driving requirements and would only accommodate four instead of six operators required by the Navy. This alternative also breached the APB cost and schedule.

After an extension to the SWO to allow the contractor more time to review alternate available technologies to reduce weight ended without success, the contract was terminated on 12 January 2006[37]. The contract was terminated for several reasons. First, the cost of each alternate aircraft course of action would require significantly more money and time to execute based on the estimates provided. Executing such a course of action without the benefit of competition was seen as unwise due to the likelihood that other competitors would protest. This is especially true if one considers that a critical factor during the source selection, which significantly impacted the Source Selection Authority's decision to select the ACS contractor, was based on the aircraft's ability to meet the requirements of payload weight, aircraft altitude and aircraft endurance. Second, during the August 2004 ASARC leading to the MS B decision, the PM had established metrics that if triggered would be cause for contract termination. Those were: "Failure to support critical milestones and failure to support KPPs"[38]. Considering the state of the contractor's performance due to the payload weight issue, critical milestones were not being met. And, while it was determined through analysis that the new system designs offered by the contractor could theoretically meet all KPPs, the NAR had expressed significant concern over the new technology development path being taken by the contractor on a critical portion of the IMINT subsystem package. Third, the Government program management team after having worked with the contractor to solve the weight issue was very concerned about the contractor's technical ability to execute the development effort. Through the many reviews of the courses of action presented by the contractor, it was apparent that the new contractor team members—both in leadership and key team member positions—brought on after SDD contract award were on a steep learning curve as to what the ACS system was to provide and how best to develop the design.

Army/Navy Government Team Relationship

The Government program management team relationship between the Army and Navy was tenuous and at times even hostile during the execution of the source selection process and the SDD contract. While there were IPT's in which the Army and Navy co-leads complemented each other well and daily activities focused on the business of managing their functional area, more times than not, the two service co-leads struggled with how to approach IPT management and interpretation of related program requirements. This struggle stems from two diametrically

opposed views of acquisition strategy. The Army's program management view of the acquisition strategy for the ACS program can be found in the ACS ORD and Acquisition Strategy documents where it states that cost will be used as an independent variable. Cost As an Independent Variable (CAIV) was the defining concept on which the initial program schedule of a five-year SDD phase was based. Of the divine triad of cost, schedule and performance, this meant that the Army expected that non-KPP performance would be flexed to maintain SDD cost and schedule. The Navy's program management view was based on meeting performance requirements. This was expressed by the Navy's PEO as a culture of NAVAIR. While meeting cost and schedule is important to the Navy, meeting all user stated performance requirements was paramount. Also, the Navy ACS program representatives believed that they had already traded as many Navy capability requirements as they believed reasonable to enable them to consider the ACS system a viable candidate to replace the EP-3E. However, this understanding did not come to light until after contract award and the Government/contractor teams were working on acceptable solutions for the system payload weight issue. Another cause of this opposing acquisition philosophy view can perhaps be linked, to a degree, back to the apportionment of the DoD budget and the differing service cultures that develop because of it. While some might say this a stretch, what cannot be denied is that the Navy does receive a larger portion of the DoD investment account budget than the Army. This might allow them a mind-set of available budget not being as great an issue as it is with the Army. In FY07 for example, the Army received 14.8% while the Navy received 23.3% of the investment account budget[39]. Interestingly, because of the Army's lack of additional budget authority to cover the Cost Analysis Improvement Group's (CAIG) increased SDD program cost estimate developed in preparation for the MS B decision, the Navy was persuaded by the Army to "buy-into" the program and provide the need $170M across the POM to meet the CAIG SDD cost estimate.

An additional factor that played into the Army/Navy relationship was the difference in management practices and team locations. The Navy side of the Government team while as large as the Army had a distinct difference in composition. While the Army used a mixture of support contractors and Government civilians who were technical experts in their area of expertise as IPT leads, the Navy ensured that all co-IPT leads were Government civilians. The Navy believed that this was necessary to ensure that each of the IPT leads could speak on behalf of the Government

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in the execution of their chartered IPT responsibilities. This is necessary because of the way in which the Navy (NAVAIR) manages the contractor efforts. Specifically, the Navy normally pairs its Government IPT lead with the contractor IPT lead and makes the Government civilian equally responsible through their performance appraisal for the cost, schedule and performance of the subsystem component development for which their IPT is responsible.

On the other hand, the Army's approach was that the contractor IPT lead was responsible for the subsystem development and its cost, schedule and performance for which they had responsibility based on contractor allocated work breakdown structure. The role of the Government IPT co-lead was to be the eyes and ears of the Government PM and to facilitate the communication exchange between the contractor and the Government to ensure that needed information/approvals and required documentation from the Government for the specific IPT was provided in the most expeditious manner. The Government IPT co-lead could not speak on behalf of the PM to make changes to work efforts unless expressed permission was given first.

Additionally, the Army and Navy Government SDD team members were located in different locations separated by an approximately five-hour drive. This significantly hampered face-to-face communications and promoted suspicion and the belief by the Navy that their voice was not being heard. The Navy also believed that a development program that included an aircraft—even if it included a non-developmental modified commercial aircraft—should be managed from an organization that focused on developing and deploying aircraft systems—specifically NAVAIR from whence the Navy team came. This played significantly in contributing to the tenuous and sometimes hostile nature of the relationship especially when combined with the differing management beliefs discussed above and the duality of the two internal Government management structures. Essentially, the ACS program had two separate program management teams with completely separate reporting chains. While the Army PM, an 05, had reporting responsibility through the Army 06 PM to the Army PEO, and AAE; the Navy PM, a GS-15, had reporting responsibility to the Navy 06 PM, who reported to the Navy PEO, who reported to the NAE on ACS program progress.

Part of this duality might be attributed to the fact that the Navy never fully joined the ACS program as directed by ACS Acquisition Decision Memorandum signed out by the DAE on 29 July 2004. The ADM called for the Navy to return to the DAE by December 2004 once the

Navy's full set of requirements had been establish, funding obtained and the combined Army/Navy APB had been established and signed out by the respective services. However, due the system design weight issues which caused the system development schedule to slip and an Initial Baseline Review not to be conducted, the Navy could not and would not commit to a cost, schedule and performance Acquisition Program Baseline. So, while the Navy was considered a full partner and had participated in the source selection process as members of the source selection evaluation board, the source selection advisory committee and in the in day to day management of the ACS SDD development program, they were not fully committed to meeting the program schedule or cost metrics as established by the Army APB under which the program was operating. Combine this with the skepticism of the Army management approach and use of CAIV to meet a five year development schedule to deliver a first ACS unit to the user by 2010, and you have a Government team that was internally divided.

Pre-System Development and Demonstration

To fully understand how and why the events unfolded during the SDD phase discussed above which led to contract termination, it is important to look back at the TD phase and the period of time between the end of TD and the SDD contract award. By doing this, several more of the pitfalls that the program faced utilizing the current acquisition system begin to take shape. Recognition of these pitfalls is the first step in identifying the lessons to be learned that may ultimately to become candidates that can be used to identify the "why" of best practices that may be adopted in the future.

The competitors for the SDD contract had been narrowed to from three to two contractors between the end of the 18-month long CE phase and the start of the TD phase of the acquisition process. Of the two contractors who continued though TD, one was considered the incumbent as they had developed and fielded the Army's current GR/CS airborne SIGINT system which ACS was intended to replace. The competing contractor, while not having the same experience, had developed and published a novel open architecture approach for integrating subsystems into the ACS system. The ACS team considered this approach to have the potential for providing ease of subsystem integration and possible competition for capability upgrades in the future. As with the incumbent, they too by the end of TD appeared to have a good understanding of the user's needs.

The ACS TD phase was a 15-month effort started in April 2002 and completed in July 2003. The program entered TD to further develop the concepts that were drafted during CE and to mitigate the development risk of critical technologies for the system development. A critical technology at risk was the SIGINT subsystem due to the cancellation of the Joint Low Band Subsystem (LBSS) program. LBSS was an Air Force led joint program expected to deliver a common airborne SIGINT technology subsystem that would be used by all three services in the development of their service unique airborne SIGINT systems. Considering the low density of airborne signals intelligence systems and the cost of developing SIGINT subsystems, this concept of developing a subsystem once and having it used by all made economic and interoperability sense. One of the reasons for its cancellation was that the increase in requirements or "requirements creep" from the three services was making the subsystem too complex and requirements too unstable to develop to. Without this SIGINT subsystem, the ACS program would have to develop its own capability during SDD. Demonstrating SIGINT design approaches during TD was a primary focus. Other risk areas addressed during TD were system's architecture and integration and multi-INT man machine interface.

The ACS program sustained a funding cut during TD in the aftermath of the LBSS program cancellation. While the Government attempted to limit the impact of the cut on contract execution, they were unable to fully mitigate the cut without de-scoping a portion of the contracted work effort. Because of the risk in the SIGINT technology area left by the cancellation of the LBSS contract, the decision was made to limit the extent that contractors were required to demonstrate ACS system level integration. The assumption was that each contractor had significant experience in integrating payloads on an aircraft based on their previous contracts for airborne system developments.

By the end of TD, each contractor had demonstrated technology risk area elements of their approaches, and showed consideration for "SIGINT System development (demonstrate feasibility of the SIGINT solutions and include a plan for the migration of the objective SIGINT subsystem); platform integration (i.e. antenna, subsystems); Multi-Node/Multi-INT system complexity, distribution of system and data across multiple ground and airborne elements; and Human Machine Interface"[40] as required by the Milestone Decision Authority. These considerations were also reflected in the five TD exit criteria that were established as the metrics

to determine if the program had matured the needed technologies to proceed into SDD. The MS B decision authority considered that all exit criteria had been met.

Additionally, during TD each contractor provided the Government with a non-proprietary draft Performance Based Specification (PBS). This PBS was based on a draft ORD furnished them by the Government early in TD. The Government later used the best from each of the draft PBS' along with the JROC approved ORD and personal experience with the current airborne SIGINT systems to create the Government PBS that was sent to each contractor team as part of the December 2003 solicitation package for the SDD contract.

Between the end of the TD phase and the ACS SDD contract award there was a 14-month period in which the Government accomplished its MS B preparation and source selection process. During this period Government/contractor interaction was minimal. With the end of the TD contract in June 2003, outside of the contractor responding to the Request for Proposal (RFP) there was little formal discussion between the contractor and the Government. However, during this period many events were occurring that would have an impact on ACS system design ultimately proposed by the contractors for SDD development.

In March 2003, just prior to the TD phase ending, the Army Requirements Oversight Council (AROC) approved the ACS ORD. While the AROC ORD was provided to the contractors immediately after its approval, it contained significant changes from the draft ORD that the contractors had been using to develop system feature to that point. Many of these changes were in the critical technology areas that the TD phase was designed to focus on. Specifically the AROC ORD required: an increase in the flight altitude of the aircraft, the need for all ACS aircraft to carry and operate SIGINT, IMINT and Satellite Communications (SATCOM) subsystems, the ability to self-deploy within 72 hours and accomplish autonomous operations for 72 hours, an increase from two operators with portable workstations to four operators with fixed on-board workstations—the additional two operators accomplishing the new requirement of Battle Command, an increase in the number of other systems that the ACS system would have to exchange data with, the implementation of a new OSD mandated reliability KPP, the implementation of specified performance numbers for the IMINT KPP, the extension of the SIGINT range and KPP targets, and the development of a tri-band SATCOM.

In addition to these changes, four additional requirements changes took place between the March approved AROC and October approved JROC ACS ORDs: The now KPP data exchange matrix was expanded again, a limitation was placed on the length and type of airfield that aircraft had to land on, the SIGINT operational frequency range was expanded, and lastly a new requirement was levied for the use of a specific type of Global Positioning System.

Following the JROC approved ORD, several derived and specified requirements of similar scope and focus as those mentioned above were placed in the Government Performance Based Specification issued to the contractors as part of the RFP in December 2003. For example, the requirements included the OSD mandated use of Internet Protocol version 6, the need for 16G crash survivability, and a specified data throughput rate for the SATCOM. This SATCOM throughput rate significantly increased the size and shape of the fuselage mounted SATCOM radome. Also, it was during this period that Army accepted the Navy's need to add two operator workstations to the system baseline bringing the total number of on-board fixed workstations to six.

While the number and type of requirements changes are significant, a independent Technology Readiness Assessment (TRA) conducted by Deputy Assistant Secretary of Defense for Research and Technology (DASA(R&T)) accomplished during this timeframe found that "the risk mitigation approaches presented by PM ACS were deemed sufficient to provide timely increase in maturity to support integration into ACS during SDD"[41]. Of the four critical technologies cited in the TRA, two of the four were found to be at a TRL 6 or higher. One technology was found to be between TRL 5 and 6 "with a viable plan to get to TRL 6 early in SDD." And, the final technology was found to be a TRL 5 again "with a viable plan to get to TRL 6 by early SDD." TRA deskbook guidance states, "that although there is no rigid requirement that every critical technology has to be at a pre-specified TRL by Milestone B, a level 6 is typical and a level 7 is preferred"[42]. Despite the reference in the TRA Deskbook, based on the DASA(R&T) assessment of the technology maturity of the ACS critical technologies, both the members of the ASARC and later the DAB found the ACS program prepared to enter into SDD.

In July 2003 ACS was designated a Major Defense Acquisition ACAT 1D Program. Based on this, the program was required to have an independent cost estimate (ICE)

accomplished by the OSD CAIG prior to going before the DAB. Due to the complexity of the types of technologies being used on the ACS program along with the recent termination of the LBSS program, the CAIG wanted the opportunity to speak to the contractors directly and to review the contractor proposals before finalizing their ICE. "This process took approximately six months with the final estimated CAIG program cost being taken into consideration during the source selection and adding to the target cost provided to each contractor for their Best and Final Offers (BAFO)"[43]. Also, because of the length of time that the source selection process took including the time to work with the CAIG on their ICE, the PM requested and was granted a six month extension to the SDD schedule by the AAE prior to presenting APB to the DAB. This timeline was also provided to the contractors to consider in the final phase of the source selection process as they submitted their BAFOs.

On 29 July 2004, the Army received MS B approval to proceed into the SDD phase. This is based on the fact the program manager demonstrated to the MDA that he had satisfactory developed all of the required DoDI 5000.2 documentation for an ACAT 1D program and that the Army had established a funding profile to meet the CAIG ICE SDD program cost. The PM for ACS developed and presented all required documents for the program including the Acquisition Strategy, Technology Readiness Assessment (TRA), and the System Engineering Plan (SEP) all of which were reviewed and approved by the appropriate authority. These are considered the key documents that layout strategy and technology readiness so often touted as the areas normally at the root of program failures. Additionally, these documents demonstrate that as the ACS program proceeded from TD to the MS B decision, the required documentation process was followed causing outside organizations to review aspects of the program's preparedness to proceed to a MS B decision as called for by the current DoDD 5000 Acquisition Process. Specifically, the TRA and the SEP received multiple reviews before final approval with the final version of the SEP (completed after contract award) being touted as an example by AT&L System Engineering that would be given to future programs as a model for the their SEP developments. Therefore, as the ACS program proceeded through the ASARC, Integrated Integrating Process Team (IIPT) and Overarching Integrated Process Team (OIPT) reviews the organizations responsible to review the program documentation and appraise the review process leadership on program readiness, all reported that the program had satisfactorily accomplished

the necessary work to proceed to the Defense Acquisition Board for final approval to move into the SDD phase. Of note is the fact that the ACS program was considered to have no major issues associated with it and therefore did not need to actually go before the DAB in the form of a singular meeting. Instead the program DAB briefing charts and required documentation package was circulated through all of the principle DAB member organizations for their approval or disapproval for entering into MS B. Based on the fact that this gave members of these organizations a degree of anonymity to more readily disapprove the package if they felt their was an issue that needed to be addressed, the fact that no organization disapproved of the program proceeding into SDD would lead one to believe that it truly was prepared to execute a successful SDD program.

ACS Pitfalls & Lessons Learned

The question to be asked is: Based on the events of the ACS Program along with the understanding of the current DoDI 5000.2 Acquisition Process documents for ACAT 1D programs as they proceed from TD and into SDD are there recognized pitfalls and lessons that can be learned that might be applied by future PMs to avoid similar pitfalls? The answer is an obvious "yes" as one may have already concluded having read the events of the ACS program described above. Additionally, while the ACS program is unique in its execution timeframe for the ACAT 1D SDD contract—only one year and one month before the Stop Work Order was issued—the pitfalls faced by the program are not unique to the ACS program but have been recognized in numerous program reviews accomplished by GAO, RAND and more recently by the Under Secretary of Defense in the Defense Acquisition Performance Assessment (DAPA) report.

Using the lens of the ACS program provides the opportunity to not only to recognize the pitfalls, but also to focus on the timeframe and context in which they occurred. The ACS program specifically brings to light those potential pitfalls that are lurking in the Acquisition Process during the TD through the beginning of the SDD phases of a Joint ACAT 1D program. Considering that this is a critical if not the most critical time in the life-cycle of an acquisition program because it sets the metrics by which program success will be measured, understanding the pitfalls and possibly avoiding them in the future has the potential to provide the Acquisition

Community the opportunity to meet cost, schedule and performance and regain the confidence of DoD leadership and Congress.

Pitfalls/Lessoned Learned

One of the most often occurring themes of an ACAT 1D program that falters during SDD is that ultimately the available budget and user requirements are mismatched. Causes for this mismatch are many but may be binned into these categories: budget cuts, requirements changes after funding is locked, or lack of well defined requirements by which the program's development cost was estimated. The ACS program suffered all of these causes from TD through the beginning of SDD. These causes come to light in many of the pitfalls faced by the program during this period[44].

Pitfall/Lesson Learned - Funding Process versus Requirements Process: Requirements Changes after Funding Locked

The budget process and the requirements validation process are not in sync. The budget process requires program funding to be locked at least two years before actual execution. This occurs while the Joint Requirements Oversight Council (JROC) now the Joint Capabilities Integration and Development System (JCIDS) process continues to develop and approve requirements documents out of sync with the budget timelines. For the ACS program, the fact that significant requirement changes occurred at the end of TD and then again between TD and SDD meant that the budget for the start of the program had already been locked and did not include the cost impact of the requirements increase. While the CAIG did require that additional funding be added to the program, because of the budget process, funding could not be added to the early years of the SDD program when it would have had the greatest impact.

Pitfall/Lesson Learned - Lack of Detailed CONOPS:
Lack of Well Defined Requirements

Interpretation and understanding of requirements does not only come from the ORD or now the Capabilities Development Document (CDD). Another source is the CONOPS which basically defines how the system will be used. Therefore, a detailed CONOPS document is needed early in the acquisition budget process to ensure that the requirements are well defined and understood. Not only will this allow for accurate program costing, but also help to avoid

requirements "creep" from occurring later in the program. The ACS program did not have a detailed CONOPS early in the program. There was a top level discussion of CONOPS in the ORD, however, due to the complexity of the program and the use of Commercial Off The Shelf (COTS) products the lack of a detailed description of how the system would be used left several requirements "hidden" until after the program funding had been locked. For instance, once the Navy joined the program and developed their detailed CONOPS it was apparent that they planned to fly several types of IMINT missions at greater frequency and lower altitude than the Army. With this information, the Government/contractor SDD program team realized after contract award that to meet the 20-year system life-span requirement, additional structure would have to be added to the commercial aircraft wing. This was not previously planned for nor costed in the contractor's system design.

Another example of CONOPS impact was the fact that ACS system was a "system of systems". Specifically, it was the airborne sensor component of a system that had a ground station component—being developed by a separate PM—that collected the airborne sensor data and then distributed it as required. Once the detailed CONOPS was developed, it was apparent that in some instances the Army intended to deploy ACS ahead of the ground station. The team realized that this would require a method for the deployed ACS system to "off-load" and secure its collected data as well as have a place from which to stage and execute aircraft and subsystem maintenance until such time that the ground station deployed if it did deploy. Again, this was an unplanned requirement and cost that was not part of the contractor's original system design at contract award.

The final example of the need for a detailed ACS CONOPS early in the acquisition cycle was because of its significant Space, Weight, Power and Cooling (SWAP-C) impact on the system design. Soon after contract award, the Government/contractor program management team was told by the user representative that all the subsystems had to operate simultaneously and at a lower altitude than had been previously thought. This "simultaneity" clarification increased available power, and cooling needs of the system. The need for increased power and cooling increased the size and weight of the cooling system and would require the addition of a larger, heavier secondary power system on the aircraft. This further exacerbated the overweight issue the ACS system design was already experiencing.

Pitfall/Lesson Learned - Joint Programs: Lack of Well Defined Requirements/Requirements Changes after Funding Lock

While Joint Service Acquisition Programs have the potential to limit overall cost of capability acquisition for DoD due to economies of scale caused by combining resources, engineering talent, and reducing logistic foot print,[45] they also have the potential pitfall of causing programs to overrun in cost and schedule[46]. If requirements are not fully vetted by each service jointly from the program inception the opportunity for a differing interpretation of requirements is likely. Specifically, "Requirement's thresholds and objectives need to be agreed to by each service early to lead to efficiency and effective" program execution[47]. However, "instability in requirements is the hall mark of joint programs"[48]. By the time the Navy joined the ACS program, the ORD had already received AROC approval. The two additional operator workstations to meet Navy needs were added prior to the ORD going before the JROC and after funding for the early phase of system development was locked. Additionally, the Navy's developing CONOPS required that the SATCOM package on the aircraft be capable of very high data rates not originally conceived in the TD phase system designs. This data rate requirement was added to the Performance Based Specification provided to the contractors in December 2003 as part of the source selection package. This requirements "clarification" had a major impact on the outer-mold-line shape of the aircraft and increased its drag coefficient that reduced the aircraft's endurance.

Another pitfall that must be considered before executing a joint development is the impact that each services acquisition philosophy and standard operating procedures will have on program execution. As discussed previously, these operating processes are not the same among services and can cause friction between the participating services during a development effort. Additionally, as stated by the Program Executive Officer for Intelligence and Electronic Warfare Systems, "Without establishing unity of command through a single joint PM office with defined service roles and responsibilities and with a single funding stream, service parochialism and competing needs will lessen service commitment"[49]. With respect to the Army and the Navy on ACS, the difference in acquisition philosophy and lack of command unity led to an impasse on which capability trades were possible as the Government team attempted to solve the payload weight issue while attempting to remain within APB cost and schedule.

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Pitfall/Lesson Learned - Design Maturity: Lack of Well Defined Requirements

The DoDI 5000.2 states "The project shall exit Technology Development when an affordable increment of militarily-useful capability has been identified, the technology for that increment has been demonstrated in a relevant environment, and a system can be developed for production within a short timeframe (normally less than five years)."[50] During the TD phase, the ACS program was forced into a situation that required the program to focus its technology risk mitigation dollars on maturing critical SIGINT technology that was initially to be provided as Government Furnished Equipment. This combined with the budget cut that the program sustained during the TD phase gave rise to a reduction in the overall breadth of ACS system design maturation and focused this phase on critical technologies development and demonstration. However, based on the definition above, it can be argued that what occurred during the ACS TD phase is in keeping with the expected level of design maturity in accordance with 5000 directive. This notion is further reinforced by the definition of what is expected to occur during the SDD phase. Specifically, DoDI 5000.2 states "The purpose of the SDD phase is to develop a system or an increment of capability; reduce integration and manufacturing risk (technology risk reduction occurs during Technology Development); …"[51] The SDD phase then is the point at which the system design is matured, and the system developed to reduce integration and manufacturing risk. However, in the ACS program it was precisely the lack of a system design before the start of SDD that left unknown many of the SWAP-C issues that contributed to the payload being overweight for the aircraft. It was the detailed system design work accomplished immediately after the initial weight issue was discovered that allowed the Government/contractor to quickly determine the extent of the payload weight issue and avoid procuring any of the system's intended aircraft. While system design in the TD phase might have brought to light the payload weight issues earlier, it would have required additional funding during the TD phase to accomplish that level of effort. However, a detailed design earlier would have provided a better understanding of ACS system SWAP-C requirements and allowed for a more accurate estimates of the SDD program which may have saved schedule and ultimately dollars in the end.

Pitfall - COTS/GOTS/NDI: Lack of Well Defined Requirements/Requirements Changes after Funding Locked

The concept of using COTS/GOTS/NDI was meant to save money on the ACS development program. However, due to unintended consequences of these items, the program struggled to close on a system design that would provide all of the user requested capability. As the extent of the SWAP-C issue became clear, what also became clear was the use of COTS/GOTS/NDI limited the contractor's ability to make weight savings trades while maintaining full capability and expected cost. The use of COTS aircraft was expected to save money in development and allow for less costly fleet maintenance during operation based on parts commonality with the worldwide fleet in the airline industry. However, the requirement for a military specification based Aircraft Qualification Plan (AQP) by the Government had a significant impact on this philosophy and the ACS system design. The contractor was allowed to modify this plan during the RFP process. However, when returned to the Government the modified plans were considered inadequate and not acceptable to the Government. Because of lack of communications between the contractor and the Government in the final stages of the source selection process, the contractor considered that the Government had accepted their version of the AQP. Based on this, and the fact that full AQP requirements implementation would have cost considerably more than had been budgeted for this effort, the Government and contractor were still negotiating the details of the ACS AQP at contract termination. Also, the extent of the expected cost savings for using COTS/GOTS/NDI software was limited because much of the code needed to be modified for use on ACS. The use of COTS/GOTS/NDI products is not a negative and can have the benefit of reducing cost and saving schedule. However, the use of these products without first having a detailed system design can lead to the issues faced by the ACS program.

ACS also encountered other pitfalls during the execution of the Acquisition Process that while they did not have a direct cause on the mismatch between funding and requirements, they did impact the efficient execution of the development effort and hence had a direct impact on program cost and schedule. These pitfalls cover areas that must be understood and considered as part of the natural progression of a program as it moves from one phase to the next in the Acquisition Process. By doing so, one realizes that the complex nature of the process includes

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circumstances over which the PM has little control but must consider if he is to develop an comprehensive acquisition approach and ultimately meet cost, schedule and performance.

Pitfall - Gap Between Acquisition Phases

The ACS program experienced a 14-month gap between the end of the TD phase and the start of the SDD phase. The reason for the gap as mentioned earlier was that the Government team was accomplishing items and events necessary to execute a contract award. Specifically, the team accomplished an ASARC, developed documentation to meet the DoDI 5000.2 MS B requirements/program execution, incorporated the Navy into the Army program management team, published a RFP, executed the SDD Source Selection Process, developed a contract, accomplished a DAB preparation OIPT and ultimately executed a "paper" DAB. While this length of time may be unique to ACS because of the system's complexity—six months was spent by the program office educating the CAIG analyst on what ACS was and the extent of each subsystem's capability so that he felt capable of providing a program cost—there is a break, for some length of time, between the end of the TD phase and the start of the SDD phase for all programs. This period of time must be accounted for because it impacts the contractor's ability to maintain critical team members and hence corporate knowledge of the program and their proposed system design. During the ACS TD phase, the competing contractors requested a "bridging contract" to allow work to continue on their designs during the interim period between phases. At the time, the Government did not have the funding to execute this request. Because of the 14-month break between phases of the ACS program, many of the critical team members were shifted to other ongoing programs within the contractor's organization. This severely hampered the contractor's ability to ramp-up development execution at the start of SDD to meet the ACS program milestone timelines.

Pitfall - Increase in Program Magnitude between Acquisition Phases

As ACS transitioned from the TD to the SDD phase, it increased from an ACAT III program to an ACAT 1D program. This impacted the contractor by forcing him to change out most key leaders on the program after contract award to put in place personnel with the experience to handle the complexities inherent in an ACAT 1D program. The result of this was the loss of historical knowledge on the program that slowed the contractor's execution of critical

program tasks while those with program knowledge trained new personnel. Additionally, the magnitude of the increase of personnel from 40 in TD to 400 in the first six months of SDD, created chaos that added to an already complex situation.

This type of personnel switch also occurred on Government team but to a lesser extent. However, this change did create a ramp-up period for the Government team in the early portion of SDD as new members from both the Army and Navy were added. In the post analysis of the program, the recommendation was made that the Government management of the program should have transitioned from an Intelligence Battle Operating System (BOS) focused PEO to an Aircraft BOS organization to ensure a better understanding of the complexities involved in aircraft integration. Specifically noted was that the "program structure and staffing were not consistent with technical and schedule complexities of an aircraft ACAT 1D program"[52]. This is an interesting recommendation considering that the major program issue was the weight of the payload design to achieve required capability. However, the development and addition of the payload on the aircraft brought with it required changes to the outer-mold-line of the aircraft and in several proposed designs to mitigate the weight issue, subtraction of fuselage sections and extensions to aircraft wings. What this demonstrates in hindsight is that the ACS system design was not as mature and contained much more risk than it should have prior to the commitment of program cost, schedule and performance more so than which organization should have been the program management lead[53].

Pitfall - Performance Based Contracting

Based on DoDI 5000.2 guidance, the ACS program concept relied heavily upon the concept of performance based contracting. Considering this, the Government issued a Statement of Objectives (SOO) discussing "what" needed to be accomplished during SDD with the expectation that the contractor would develop a detailed Statement of Work (SOW) describing "how" they would accomplish the effort. To ensure that the contractor had the ability to create an effective SOW, the SOO required that the contractor and critical subcontractors be certified at least at a Capability Maturity Model Integrated (CMMI) level 3 at the start of SDD. CMMI level 3 requires that an organization have mature processes in place by which to accomplish work efforts. While the contractor claimed to be at this level—the contractor's corporate headquarters had recently been certified at the higher CMMI level 5—what became apparent after contract

award was that the contractor team with responsibility for the ACS program was not operating at any discernible CMMI level. This was due in large part to the change in personnel and the training level of the new team on this corporate division's processes. Based on an internal contractor analysis, they expected to begin operating at a CMMI level 2-3 within a year and a half after contract award. This played a major role in contractor's inability to execute in an efficient and competent manner as seen by the Government adding to the potential for expected cost and schedule growth[54][55].

Pitfall - Competitive Optimistic Contractor Proposals

The ACS program suffered from a reoccurring situation within the current Defense Acquisition Process. What became evident after contract award and during open program execution discussions was that the contractor's proposed costs were overly optimistic. The contractor made it clear after award that due to the competitive environment of the source selection, the program cost bid in the final proposal was a "win" or "buy-in" cost accurate only if the program executed with very few if any of the expected program risks being realized. Considering that historically the Government normally continues large programs even after they have breached their APB, adding additional funding and then reestablishing the program baseline, it appears contractors have very little motivation to provide realistic expected costs in their proposals. Part of the blame for this situation in ACS could rest with the Government because they supplied in the RFP the available budget for each year of expected SDD contract execution. However, this was done in an attempt to ensure the competing contractors provided a best value proposal considering available cost, schedule and requested capability. In the recently published DAPA study, a new approach is discussed that would fix the parameters of estimated program cost and schedule, and only allow the changing of program performance for a given development spiral to ensure that the first two parameters are achieved[56]. This could fix the issue of cost breaches in the future.

Pitfall - Pre MS B Program Readiness Assessment

In the execution of the current Acquisition Process, the ACS program accomplished an ASARC, several OSD IIPTs, an OSD OIPT and a "paper" DAB. What becomes apparent looking back on these meetings and the additional reviews prior to these events is that the

program was never reviewed in a detailed synergistic fashion until the program was experiencing development issues. Prior to MS B, each subject matter expert (SME) that reviewed the various program aspects/documents did so without detailed consideration for the other areas of the program. The leadership at the major reviews mentioned above were presented with a comprehensive briefing of all aspects of the program, but had to rely on the SMEs to accomplish the detailed analysis that provided insight into possible problem areas. With each SME returning a vote of confidence in his or her area of responsibility, this naturally provided the leadership a positive assurance that the program was prepared for entry into SDD. Considering the results of the Independent NAR Team's assessment of the ACS program, it is apparent that had a synergistic review approach been taken prior to MS B, several of the major program disconnects would have been discovered. Key to the success of this approach is the experience level of the independent review team members and their focus areas. In the case of ACS, the assembled NAR team was composed of very senior acquisition professionals who had "a combined 700 years of experience" from both the Army and the Navy. Their focus was to:

- Assess program scope with respect to cost/schedule/performance (including Program Management/Organization/Experience, risks, acquisition strategy, etc)

-Provide "pre-decisional" findings and recommendations to Army and Navy PEOs.

- Suggest "path forward"[57].

Pitfall - Corporate Sponsorship for Acquisition Programs

While important, the level of Corporate Sponsorship in the civilian industry sector is not equaled within DoD. Civilian sector corporate leadership marshals all resources requested by a program manager to develop and bring a product to market as fast as possible. Therefore, the only focus area of a civilian PM is bringing the product to market. In DoD, there is not the same alignment of corporate sponsorship for product development. In DoD, corporate sponsorship is accomplished by what is called the big "A" ("A" being the Acquisition Community which includes not only the PM/Acquisition work force, but also the senior Army, OSD leadership and Congress that have purview over the resources for product development). However, currently in DoD the differing focuses of the big "A" members does not usually align sponsorship for development projects on the single goal of bringing a product to the customer. Without this big

"A" sponsorship, the DoD PM must focus on developing and bringing to market his product and also attaining and then defending the necessary resources to make this happen. Because of this lack of big "A" sponsorship the DAPA report stated, "no program has ever been plused up in funding during development"[58]. To this point, the opposite appears to be occurring; the Assistant Secretary of the Army for Acquisition Logistics and Technology recently said, "the Future Combat System has been cut $830M since its MS B decision in 2003 and it is a successful program having remained on cost and schedule since its inception"[59]. To minimize the impact of the current lack of big "A" sponsorship, a program must get to production as soon as possible. To accomplish this, technology for a single development spiral must be at a level of maturity to reduce time for product development.

Why Pitfalls Happen

Considering that DoD is executing a knowledge-based acquisition process that mirrors the successful commercial sector's process, why is it that the ACS program suffered from the pitfalls that it did? And more generally, why is it that of the 85 ACAT 1D programs reported in the FY06 Selected Acquisition Report, 40 of them reported Nunn-McCurdy unit cost breaches with 25 of those reporting a breach of 50% or more compared to their original cost baselines? Congress considers the situation so bad that in the first sentence of the HASC FY2007 National Defense Authorization Act, Acquisition Policy and Management section they stated emphatically "…the Department of Defense (DOD) acquisition process is broken." The second sentence is even more damning stating "The ability of the Department to conduct the large scale acquisitions required to ensure our future national security is a concern of the committee." They further cite that "the rising costs and lengthening schedules of major defense acquisition programs lead to more expensive platforms fielded in fewer numbers." The very issues that the current Defense Acquisition System was suppose to fix are still issues. The question is why?

Answers to the above questions might be found in February 2006 DAPA report commissioned by Deputy Secretary of Defense. As discussed in the previous section but with further elaboration here, the DAPA team of experienced acquisition professionals recognized that the Defense Acquisition System is a complex integration of three competing processes. These three competing processes are the acquisition, budgeting and requirements processes

which they term collectively as the "big A" acquisition system. The current DoDD 5000.1 based acquisition process they term as the "little a" stating that it does not include the requirements and budget processes. Figure 3 provides a graphical depiction of this[60].

Figure 3. DAPA's Acquisition System

This competition within the "big A" system is caused by the differing component process' motivational factors described in the red and black text in Figure 4. While in theory there exists a workforce, organizations and industry which should work together to force the three separate processes of "big A" into synergy and ultimately develop a needed warfighter capability on target cost and with defined schedule, in actuality these "forcing entities" have competing values of their own which make this impossible. Figure 4 shows this concept providing the differing values in blue[61].
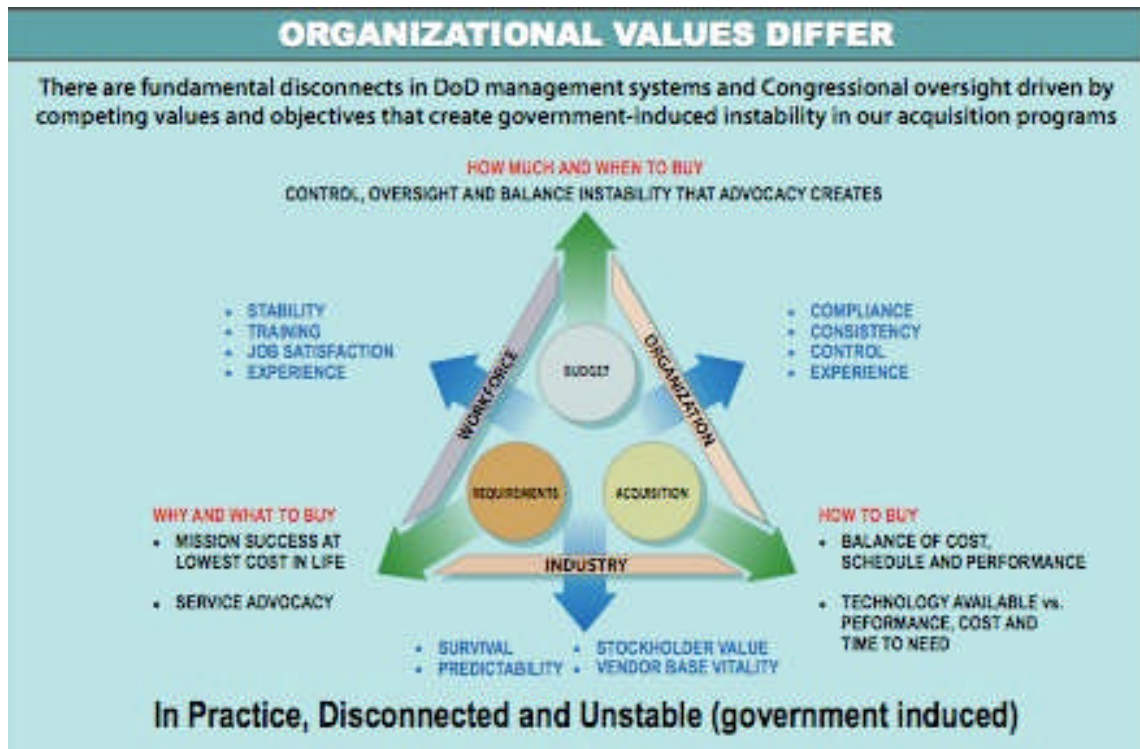
Figure 4. DAPA's Organizational Values Differ..

These competing motivational factors of the "big A" processes and competing values of the forcing functions cause instability in the Defense Acquisition System that they define as being comprised of the six internal elements of budget, requirements, acquisition, industry workforce and organization. This instability in the Acquisition System is what they claim "results in a situation in which senior leaders in the Department of Defense and Congress are unable to anticipate or predict the outcome of programs as measured by cost, schedule and performance"[62]. Eight Major Findings resulted when the DAPA "reviewed the defense acquisition performance and documented the integrated nature of the process." These are listed in Figure 5[63].

MAJOR FINDINGS

- Strategic Technology Exploitation
  - Key U.S. Advantage
- The U.S. Economic And Security
  Environments Have Changed
- The Acquisition System Must
  Deal With External Instability
- DoD Management Model Based On
  Lack Of Trust
- Oversight Is Preferred To Accountability
- Oversight Is Complex
  -- Not Process or Program Focused
- Complex Acquisition Processes
  Do Not Promote Success
  -- They Increase Cost And Schedule
- Incremental Improvement Applied
  Solely To The Little "a" Acquisition
  Process Requires All Processes
  To Be Stable - They Are Not

Figure5. DAPA's Major Findings

Based on these major findings the DAPA project made reform recommendations designed to improve all of the six internal elements of the Acquisition System. The summary of each of the recommendations is found in Figure 6[64].

OVERVIEW

- *Organization*
  - Realign authority, accountability and responsibility at the appropriate level and streamline the acquisition oversight process.

  - Establish dedicated Four-Star Acquisition Systems Commands, at the Service level.

- *Workforce*
  - Rebuild and value the acquisition workforce, and incentivized leadership.

- *Budget*
  - Transform the Planning, Programming and Budgeting process and establish a distinct Stable Program Funding Account.

- *Requirements*
  - Replace the Joint Capability Integration and Development System with the Joint Capabilities Acquisition and Divestment Plan (a Combatant Commander-led requirements process in which the Services and Defense Agencies compete to provide solutions.)

  - Establish a two-year recurring process to produce an integrated, time-phased and fiscally-informed Joint Capability Acquisition and Divestment plan and a continuous Materiel Solutions Plan Development Process to identify and initiate development of Materiel Solutions.

  - Add an "Operationally Acceptable" test evaluation category.

  - Give program managers explicit authority to defer non-Key Performance Parameter requirements to later spirals or block upgrades.

- *Acquisition*
  - Adopt a risk-based source selection process.

  - Shift to time-certain development procedures and make schedule a Key Performance Parameter.

  - Mandate a time start and end dates that are clearly defined and revamp the acquisition processes to support it.

- *Industry*
  - Overcome the consequences of reduced demand by sharing long range plans and restructuring competitions for new programs.

  - Require government insight and favor formal competition for major subsystems when a Lead System Integrator acquisition strategy is pursued.

Figure 6. Overview of DAPA's Findings.

Their review of acquisition reform history shows that many of these issue areas contained in their major findings had been incrementally addressed over time via similar recommendations

in previous calls for acquisition reform. However, DAPA notes that for the incremental approach of acquisition reform to be successful in improving cost, schedule and performance it requires that "all six internal elements of the (Defense) Acquisition System (organization, workforce, budget, requirements, acquisition and industry) must operate in a stable and predictable manner." Also, they stated "that external influences on the (Defense) Acquisition System, including leadership and congressional oversight, must exert stabilizing and predictable guidance. None of these processes and influences are stable and predictable today"[65]. Therefore, they conclude that to provide the Acquisition System the required "stability and continuity" that it needs to succeed, the approach must be to improve all six internal elements (organization, workforce, budget, requirements, acquisition and industry) at once. Hence, they leave one to conclude that the lack of simultaneous implementation of previous calls for reform is the reason for their lack of success.

Noted in the DAPA study but not called out as a reason for the failure of previous reform studies to produce a successful acquisition process is that not all elements of the previous studies were fully implemented. Considering that implementing improvements in all the six elements simultaneously is the only way the DAPA study team says DoD can gain the needed stability in the Acquisition System for it to be successful in predicting program cost, schedule and performance, it is interesting that no rationale is given for why the previous reform initiatives were not fully implemented. Specifically, the DAPA study noted that the 1986 President's Blue Ribbon Commission on Defense Management National Security Planning and Budgeting (Packard Commission) call for organizational reform—while similar to their own—was never fully implemented. DAPA stated that the Packard Commission recognized that successful organizations have "short, unambiguous lines of communication among levels of management, small staffs of highly competent professional personnel . . . [and] most importantly, a stable environment of planning and funding." The DAPA study found that this concept was never fully implemented and recommended as its first measure for organizational reform "…to implement the intent of the Packard Commission more fully and regain stability in the Acquisition System by realigning authority, accountability and responsibility at the appropriate levels"[66].

Reviewing the Packard Commission's study reveals that it also found that the previous calls for reform were not fully implemented. Specifically the commission noted that the reform

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initiatives called for by President Eisenhower during his presidency based on lessons learned from World War II were never fully instituted. The Commission stated:

> "The present structure of the Department of Defense (DoD) was established by President Eisenhower in 1958. His proposed reforms, which sprang from the hard lessons of command in World War I and from the rich experience of his Presidency, were not fully accomplished. Intervening years have confirmed the soundness of President Eisenhower's purposes. The Commission has sought to advance on the objectives he set for DoD"[67].

Like the DAPA study the Packard Commission also claimed as a goal the desire to "advance on the objectives" that their predecessor had set with respect to acquisition reform. Immediately following the publishing of both the Packard Commission's interim and final reports this seemed to be occurring. After the reports were published there was a flurry of activity by both the Congress and DoD to implement several of the reform initiatives. However, in the end, the reform initiatives were only ever partially implemented[68]. The same set of events appear to be occurring with the DAPA report. In the 2007 National Defense Authorization Act, the House Armed Services Committee (HASC) commented on many of the major findings of the DAPA study recommending that DoD should be implement the findings. Section 804 of the Act goes further and requires that DoD provide quarterly reports to the HASC and Senate Armed Services Committee on the DoD's implementation of the DAPA, The Defense Science Board Summer Study on Transformation, The Center for Strategic and International Studies: Beyond Goldwater-Nichols Study, The Quadrennial Defense Review and The Committee Defense Review of the House Committee on Armed Services recommendations. However, in the next paragraph of the section the committee calls into question the Defense Departments ability to "analyze and synthesize these reform recommendations into a series of meaningful and actionable implementation plans." They state that in the last 20 years DoD has been unable act on the recommendations made by the numerous reform studies and that the "same challenges identified by the Packard Commission including rampant cost growth, unreliable cost estimates, and requirements relying on immature technology increasing overall program cost" still remain issues today.

> "Bureaucratic impediments, changing senior leadership, and numerous other factors prevented implementation of major acquisition reform despite comprehensive studies on

the subject. In particular, the committee notes that the President's Blue Ribbon Commission on Defense (1986), commonly known as the ''Packard Commission,'' recommended numerous reforms to the acquisition system that, despite the efforts of Congress and the Department, have not been fully realized. Nearly twenty years later, the four major acquisition reform studies of 2005 identify the same challenges identified by the ''Packard Commission'' including rampant cost growth, unreliable cost estimates, and requirements relying on immature technology increasing overall program cost. The committee is concerned about the ability of the Department to solve these decades' old problems"[69].   —HASC 2007 National Defense Authorization Act

While calling into question the DoD's ability to implement acquisition reform, the Act's language does little to impose reform changes itself. For example, while Section 813 of the 2007 Act language does require that DoD implement "time-certain development" as called out by the DAPA study; it does so only for Information Technology Business Systems. The language requires that these "…systems be fielded within five years of the system entering the technology development phase of the acquisition process, known as Milestone A approval"[70]. Discussion of one of the most far-reaching DAPA reform initiative is nowhere to be found. The major organization change initiative called for in the DAPA study of establishing four-star System Commands for Acquisition under each service's Chief of Staff/Chief of Naval Operations to unify acquisition, requirement, and budget process command authority is not even mentioned by the Act.

So while Congress is requesting action by DoD to fully implement the reform initiative called for by the DAPA report and others, it has little faith this will happen. And, knowing this Congress has taken few steps to implement these initiatives. Based on the historical record, the highest probability of outcome is that only a portion of DAPA's initiatives will be implemented within DoD as has been the case with all other reform initiatives in the past. Therefore, while the DAPA study may explain why the current Acquisition Process is unable to reliably execute major defense acquisition programs within cost, and schedule for the required performance, it will probably do little to change this situation.

Experience Counts

The reality is that the Acquisition Process is not as "broken" as has been stated above. If the process were truly broken as described, we would expect that DoD would never be able to execute an ACAT 1D program and provide required capability within budget and on schedule.

This is not the case. There are in fact large acquisition programs that are executing within the Acquisition Program Baseline (APB) parameters set at the start of the program's SDD. The same SAR data previously discussed shows this fact. While the final SAR submission of FY06 showed that of the 85 programs submitted 40 of those were in Nunn-McCurdy breach of their APB, what it also says is that there were 45 programs which were not in breach of their APBs. Considering this and the fact that two of the largest ACAT 1D acquisition programs in both the Army and the Navy (Future Combat System and Multimode Maritime Aircraft) are executing within established parameters,[71] several reviewers of the Defense Acquisition System have said that it's not the Defense Acquisition Process at all but instead the "experience and discipline" of the PMs and the acquisition leadership to effectively implement the Acquisition Process that is causing the current situation[72][73]. As a matter of fact, comments concerning PM/acquisition workforce education and experience levels have been made by almost every major acquisition system reform study to date. In the DAPA study—as with the Packard Commission—the researchers noted that many PMs lack the "experience and expertise" in all facets of program management needed to successfully execute a program within established cost, schedule and performance. Specifically, the two studies stated:

> "Experience and expertise in all functional areas has been de-valued and contributes to a "Conspiracy of Hope" in which we understate cost, risk and technical readiness and, as a result, embark on programs that are not executable within initial estimates. This lack of experience and expertise is especially true for our program management cadre"[74]. —DAPA

> "Each year billions of dollars are spent more or less efficiently, based on the competence and experience of these personnel. Yet, compared to its industry counterparts, this workforce is under-trained, underpaid, and inexperienced. Whatever other changes may be made, it is vitally important to enhance the quality of the defense acquisition workforce"[75]. —Packard Commission

The DAPA report also notes that DoD has "no consistent training or experience requirements… for these key skills and training and certification standards are not enforced"[76].

Based on these finding, it is evident that experience levels can vary among PMs and the acquisition leadership. Based on this, it should be expected that PMs might not have the requisite experience before entering an acquisition program in a particular stage of the acquisition process. PMs like other members of the acquisition and military workforce are placed into positions of

ever increasing responsibility based on their past performance and their potential future ability. Although they may have superior performance and potential, without the appropriate experience they may not understand the potential pitfalls inherent in the current acquisition process at a particular phase. The Aerial Common Sensor (ACS) program is a case in point. Had the ACS PM and the Army leadership been aware of the best practice process pitfalls of the current Defense Acquisition System as the program transitioned from TD to SDD they could have avoided some if not all of the issues the program faced.

Recommendations: Consider Experience and Process Improvement

An obvious way to correct the lack of experience situation in the future might be to ensure that only PMs with the appropriate experience are placed in complex Major Defense Acquisition Programs (MDAP) in a particular phase of the acquisition process. While this is possible from a centralized career management stand point, it is probably not practical. After a few rounds of matching experienced PMs to programs in particular phases of the acquisition process, DoD would run out of experienced PM because of the "catch-twenty-two" of other PMs not being able to gain requisite experiences to qualify them for MDAP programs. While the axiom in life is that we learn more from our mistakes than our successes, in the world of DoD MDAP programs, management mistakes can be costly. Hence, using unqualified PMs can keep DoD in the current situation.

DoD could look outside the Department for a fresh infusion of experienced personnel. This would probably not be optimal for two reasons. First this solution would not provide DoD PMs a worthwhile career progression path. Second, PMs from outside DoD would not have DoD specific program management experience. PM experiences are just that—his or her experiences—limited to the experiences that they have had. These experiences by definition are not benefited by the breadth of experiences that other individuals and organizations have had. Also, while experience is a "great teacher" the level of lessons learned by a PM from his experiences depends on "whether the student was paying attention"[77].

A solution to this dilemma is education. Specifically, education gained by combining training on current Defense Acquisition System theory with the lessons learned from PM experiences with the pitfalls of the Defense Acquisition System. PMs educated in this way would

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understand the current acquisition process to include the benefits of the required best practices and lifecycle documentation that have proven successful in commercial industry. And, they would also understand that the current Acquisition Process has pitfalls that must be mitigated to succeed in developing a system within defined cost, schedule and performance. By doing this, DoD can develop knowledgeable PMs from within the current and future DoD PM pool that are prepared to optimize a program for success even without personal experience with all the acquisition process pitfalls themselves[78].

Considering that the Defense Acquisition University (DAU) currently trains PMs on the Defense Acquisition System theory, it would only need to add sections on lessons learned by PMs from experiences that they have had with the pitfalls with the current acquisition process. These experiences can be captured using the Army's After Action Review (AAR) process. This process has been a very integral part of the National Training Center's success in training the world class Army currently fighting in Iraq. This process has also been used in commercial business sector as part of their process for reviewing commercial development programs. Bart Perkins, who is a managing partner at Leverage Partners Inc., recently published in his monthly column for the management section of Computerworld magazine a business focused synopsis of the AAR process. In his article, the process is called Post Project reviews (PPR). Considering its project management focus, this process is well suited for use in the business of Defense Acquisition. Perkins starts by stating that the "cornerstones of a successful PPR are effective leadership, thorough preparation, committed participation and follow-through." For effective leadership, he recognizes that "senior project managers with experience and perspective" and who are free of the program's "politics" must be chosen to lead the effort. This can be accomplished in DoD by assigning a team of senior experienced acquisition personnel from DAU augmented as necessary by other PMs and senior acquisition functional area specialist to a program review team.

While effective leadership is important, Perkins states that thorough preparation must not be "minimized or eliminated" as it often is because it is a "crucial step" in the success of a PPR. Through proper preparation the effectiveness of the PPR is "significantly enhanced". It also "shortens the length of PPR meetings and reduces the number of arguments." To prepare properly, Perkins says, the leadership team must:

- **Reassess Project Content**: review program "documents, including the business case, work plans, change requests and contracts. Critically reexamine business goals, project objectives and assumptions, as well as risks and associated risk mitigation strategies."

- **Analyze Statistics**: "Compare initial estimates of projects costs, schedule and deliverables with actual data. Significant differences (increases or decreases) usually indicate insufficient research or unforeseen obstacles. Gauge overall project stability by assessing revisions to scope, budget, schedule and resources."

- **Interview Project Participants**: "Interview key project team members and executives to add important perspective, especially for contentious issues. Interviews frequently reveal unrealistic (often mandated) deadlines, overly constrained budgets, insufficient staffing, inadequately tested software packages or corporate in-fighting, which greatly affect project success."

- **Establish PPR Meeting Logistics**: "Determine participants (in PPR meeting). Include key representatives for all groups that worked on (or benefited from) the project, as well as multiple levels of management…" "Multiple meetings or videoconferences may be required. E-mail is not acceptable."

Perkins further states under the heading of Participation that "the PPR meeting should address these questions:

- **What went well, and what didn't?**
- **What obstacles impeded the project and what would have helped?**
- **Where do processes need to be altered, improved or replaced?**
- **How effective were project communication and executive support?"**

To succeed these meetings must "maintain a constructive, non-adversarial focus, and aim for a reasonable level of consensus."

However probably the most important part to the PPR process is the follow through. Just having information about a program's highs and lows does not provide change. "Results must be integrated and published…without conscious effort and commitment to improvement, few changes will occur and subsequent PPRs will reveal essentially the same problems…Many companies assume that unsuccessful projects are exempt, but failures offer invaluable opportunities for learning…"[79].

In DoD, PPRs should be accomplished when a MDAP program completes a phase of the acquisition process, at program/contract cancellation and following a program's execution of a Milestone decision. Conducting a PPR at the end of a phase of the acquisition life-cycle and at program/contract cancellation will provide specific insight into the peaks and pitfalls that a program faced while those events are still fresh in the minds of the program personnel and relevant program documentation is readily available. Executing a PPR following a Milestone decision provides feed back on the unwritten approval and briefing process along with the memorandum and documentation content that an ACAT 1D program must accomplish in preparation for a specific Milestone decision. Creating a historical record that others can use with which to prepare for a Milestone decision can add consistency and reduce the difficulty a PM currently has with obtaining useful information on the Milestone briefing process in a timely manner. As a PM marches down the path to a Milestone decision, he must query each organization responsible for the briefings and required documentation content on exactly what is acceptable. Without a standard operating procedure for the specifics required in each organization's documents/briefing charts, the PM must provide content that is to the satisfaction of the individual action officer on duty at the time of his Milestone decision[80][81].

As these PPRs are accomplished, the information obtained can be used in developing the DAU course curriculum for PMs on pitfalls and successes of ACAT 1D or MDAP programs. Perhaps this curriculum can be tailored for each PM based on the ACAT 1D program and the specific phase of the acquisition process the program is in or will be entering. This curriculum should be added to the current courses required for PMs who have been slated to manage ACAT 1D programs. Later these courses could be expanded to include ACAT III program managers. However, a very important aspect of the DoD PPR process is that the data collected from this process must not focus on placing blame or have as an end goal a focus of providing input to a PM's annual performance evaluation. Should this happen, the process will no longer provide honest feed back as PMs are forced to influence the characterization of their programs to avoid a negative performance assessment.

In addition to creating courses that include PPR information, DAU should create an online Program Expert System, available to all PMs that database the collected PPR information. This expert system would make available the relevant PPR information in a format that a sitting

PM would be able to query. Specifically, the system would provide PMs the ability to parse the information based on several defining criteria such as program phase and system specifics. For example, once established, a PM could query the database for all pitfalls faced by an ACAT 1D program that is heading to a MS B decision, is expected to be a joint service development, aircraft based, and is in the intelligence functional domain. The ACS program information and pitfalls faced could be used as an initial set of data for such a database and query.

Continuous Process Improvement

Educating PMs on the current potential pitfalls in the Defense Acquisition System is only a part of the follow-through discussed by Perkins above. The next step is to develop a method to improve the system by eliminating the errors in the current acquisition process that cause pitfalls. Based on the specific knowledge gained about the issue areas of the Defense Acquisition System from the PPRs, focused improvements can be made only to those areas that need improvement. As discussed earlier, the entire acquisition process is not broken, but there are errors in the system that must be corrected to make the acquisition process more efficient and effective and less reliant on individual PM experience. This is not something that can be accomplished by a one-time set of comprehensive changes as has been previously attempted by the numerous acquisition reform studies. Instead, these improvements must be made continuously over time to be effective[82]. The framework to accomplish such an effort is found in the Continuous Process Improvement concept currently being embraced by DoD Business Transformation[83].

On 11 May 2006, the Deputy Secretary of Defense, Honorable Gordon England signed a cover memorandum to the recently published Continuous Process Improvement (CPI) Transformation Guidebook. This memo was addressed to all DoD subordinate organizations and mandated the establishment of Continuous Process Improvement Programs throughout DoD. In the memo he stated: "The Secretary and I expect that every DoD organization is focused every day on improving the effectiveness of our support to the Warfighter." "…CPI has proven to be an important tool for improving the operating effectiveness of the DoD, not only within the logistics and acquisition activities, but also across the full range of operational, administrative, Science and Technology, and support functions. We should continue to broaden and accelerate the use of these tools to further improve effectiveness"[84].

This memo and the accompanying CPI Transformation Guidebook are part of an ongoing process to change the way DoD executes its mission that began with the Secretary of Defense's calls for DoD Business Transformation back in 2001 with release of the Quadrennial Defense Review (QDR) of that same year[85].

> "…And that means we must recognize another transformation: the revolution in management, technology and business practices. Successful modern businesses are leaner and less hierarchical than ever before. They reward innovation and they share information. They have to be nimble in the face of rapid change or they die."
>
> - Donald H. Rumsfeld, Secretary of Defense, September 10, 2001[86]

The QDR finds its roots in the words of President Bush's FY2002 President's Management Agenda that called for reform across the Executive Branch of Government in a effort to "improve federal management and deliver results that matter to the American people." In this agenda "five government-wide… and nine agency specific reform" initiatives are discussed in results based framework. For each initiative: the problem is presented, followed by the initiative to fix the problem, then the expected short-term and long-term "results" or metrics by which to measure the initiatives success.

This call for transformation continues in the latest 2006 QDR where the concepts for reform have been refined with more focus provided about how to proceed. Organizations such as the Defense Business Transformation Agency have been established to manage and coordinate DoD transformation efforts to provide unity and leadership for the process improvement efforts. The Agency's focus is "…on bringing the needed capabilities to the joint force more rapidly, by fashioning a much more effective acquisition system and associated set of processes"[87]. Additionally, the 2006 QDR calls for specific reforms to the acquisition process based on the DAPA report. For instance, the QDR calls for the reduction of cycle-time to deliver a product stating, "acquisition development and procurement will shift to a time-certain approach." It also requires that cost, schedule and performance will be aligned "early in program development, senior leaders will make the key-tradeoffs necessary to balance performance, time and available resources." The 2006 QDR further echos the specific reform initiatives called for by the DAPA report by stating: "Upgrades and improvements can be added in subsequent spirals based on the

maturity of the technology. Combining time-certain development and procurement of capability with a risk-based approach to source selection should provide much greater stability in the acquisition system. Stability should allow for more predictable acquisition programs measured by cost, schedule and performance"[88].

The President's Performance Agenda and the QDR provide the impetus for reform and demand that the process of reform be customer focused and results based. What the use of the CPI framework does is to provide a method within DoD to accomplish this customer and results based reform. The CPI framework provides methods, when applied correctly, will force a process to be reshaped to provide value and meet the warfighter's needs. CPI also forces the process to become metric based to allow success to be measured and provide information that defines how process improvement should proceed. Customer focus and measurements based process improvement are key components of CPI[89].

"DoD CPI is a strategic approach for developing a culture of continuous improvement in the areas of reliability, (reduction in) process cycle times, costs in terms of less total resource consumption, quality, and productivity"[90]. To accomplish this, CPI practitioners have several tools available to use depending on the nature of the process to be improved. Lean, Six Sigma, and Lean Six Sigma are several of the tools available. To use these tools effectively the proven five phased model of Define, Measure, Analyze, Improve, Control (DMAIC) is used to give the process improvement team a framework for problem solving as they apply the process improvement tools.

Lean is a tool that focuses on speeding up the cycle-time to delivery of a product. This is accomplished by identifying and appropriately eliminating "waste or non-value added activities from a customers perspective. …Waste is defined as the activity or activities that a customer would not want to pay for and/or that add no value to the product or service from the customer's perspective. At the heart of lean is the determination of value. Value is defined as an item or feature for which a customer is willing to pay. All other aspects of the process are deemed waste. Lean framework is used as a tool to focus resources and energies on producing the value-added features while identifying and eliminating non value added activities"[91].

Six Sigma is a tool designed to eliminate errors in process. To accomplish this, Six Sigma "measures how many defects exist in a business process and then systematically determines how

to remove them. Its focus is on process quality. …The principles of quality applied in implementing Six Sigma are almost always defined in terms of the company vision and its strategy. Processes are designed from the perspective of the customer and involve an infusion of process thinking across the firm. Metrics such as performance, reliability, price, on-time delivery, service and accuracy provide the targets"[92].

Lean Six Sigma is a combination of both tools. The thought is that successful process improvement requires the complementary nature of the two tools. Specifically, Lean provides the "increase in the velocity" of the process and Six Sigma provides the "quality" in the process. "The fusion of Lean and Six Sigma improvement methods is required because:

- Lean cannot bring a process under statistical control
- Six Sigma alone cannot dramatically improve process speed or reduce invested capital
- Both enable the reduction of the cost of complexity"[93].

Solution

By combining PPRs with the CPI process/tools and using them to assess the Defense Acquisition System, DoD can solve its problem of being unable to predict cost, schedule, and performance. As stated above, PPRs when executed correctly, will define the errors/pitfalls within the current Defense Acquisition System. Using the PPR method of problem definition provides an understanding of the systems pitfalls from the perspective of two important customers of the Acquisition Process—the warfighter and acquisition professional. Hence using PPR provides the first phase (Problem Definition) of the problem-solving framework within CPI (DMAIC). With the problem appropriately defined, the remaining phases of the CPI problem-solving framework can be implemented. This is accomplished by using CPI tools (Lean, Six Sigma, or Lean Six Sigma) to focus efforts on what needs to be measured, analyzed, improved and controlled. Iterations of the CPI process will ultimately improve the Defense Acquisition System and provide an Defense Acquisition Process that can reliably predict cost, schedule and performance.

Immediate Process Improvement

Considering the pitfalls encountered by the ACS program during program execution—discovered by reviewing program events both during and post contract execution—one easy pitfall eliminating process change to the Defense Acquisition System stands out. This change is to require that all ACAT 1D programs have an Independent Program Readiness Assessment (IPRA), conducted by experienced senior acquisition personnel, accomplished before they are permitted to proceed to a Milestone decision. This change takes advantage of the key lesson learned from not only the ACS PPRs which demonstrated the benefits of a synergistic review of a program's readiness to proceed to the next acquisition phase, but also the many acquisition reform studies over the years that recognize that experience plays a major role in a program manager's ability to understand his environment and foresee the potential pitfalls that could impact his program. Additionally, the independent nature of the review will ensure that program politics and emotion do not cloud the determination of a program's readiness to proceed to the next phase of the acquisition process. The independent assessment team would execute an experienced based review of the program and provide the PM and his PEO with its synergistic assessment of the program's risks that could impact successful execution if realized. With this knowledge, a program manager can take action to avoid or mitigate the potential pitfalls allowing him to accurately establish and then maintain program cost, schedule and performance.

Summary & Conclusion

The Defense Acquisition System remains intolerably undependable in its ability to deliver needed capability within cost, and on schedule to its most important customer—the Warfighter. This situation is not new and has been the subject of many Acquisition Process reform studies over the past 35 years. The implementation of these initiatives has resulted in the current best practices based Defense Acquisition System. Despite the improvements in the Acquisition Process, the most recent studies continue to find the same basic issue of a process being unable to deliver capability at estimated cost and schedule. Because the reform study initiatives have never been fully implemented, the Acquisition Process continues to be fraught with potential pitfalls that still plague large MDAP programs. The Congress noted in their 2007

National Defense Authorization Act that for many reasons they do not expect this situation to change. Despite the current situation, some programs are successful.

Reform studies and Post Project Reviews, to include the review of the recent ACS program, have shown that experience appears to hold the key to recognizing potential pitfalls that cause program breaches and mitigating them before they are realized. Based on this, DoD should conduct PPRs on all ACAT 1D programs as they complete phases of the acquisition life-cycle and Milestone decisions. The identified pitfalls of the Defense Acquisition Process should then be placed in a database and used to train inexperienced PMs on potential program risk areas. This database should also be the foundation for the development of a Program Expert System that sitting PMs can access as part of their program planning process to identify relevant potential pitfalls that they may not normally recognize based on their past experiences. The pitfalls recognized in the ACS program should be used to populate the database with those pitfalls that can occur in an ACAT 1D program as it transitions from TD to SDD.

Calls for Business Transformation in the Executive Branch and within the DoD specifically, have set the stage and established the requirement to use the framework for process improvement known as Continuous Process Improvement. CPI when combined with the PPR process enables the identification of pitfalls within the current best practices based Defense Acquisition System and then provides a methodology to fix them. Specifically, this combination provides the information and tools necessary to correct the pitfalls in the current Defense Acquisition System to ensure that programs can meet cost, schedule and performance. Additionally, DoD should establish an experienced team of DoD personnel who represent all facets of the "big A" Defense Acquisition System and are trained in the art of PPR and CPI to conduct an ongoing analysis of the Defense Acquisition System, identify its potential pitfalls and establish approaches and policy to eliminate these pitfalls from the Acquisition Process. By doing this, DoD will ultimately be able to regain the confidence of the senior leaders, Congress and most importantly the Warfighter since the Defense Acquisition System will finally have the ability predict and execute MDAP programs on cost, within schedule and at the required level of performance.

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